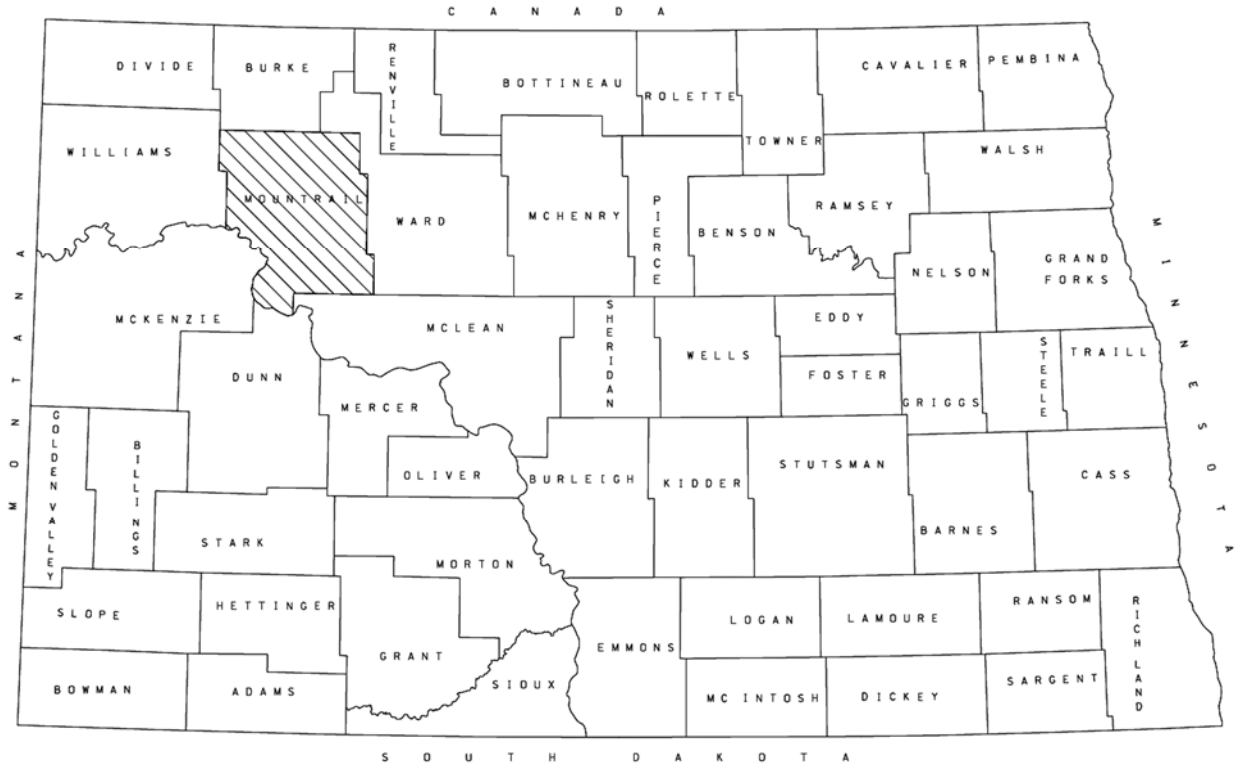
LINEAR SOILS SURVEY AND RECOMMENDATIONS

PROJECT NO. SOIB-7-023(057)046

PCN 22159

COUNTY Mountrail

ND 23, RP 46.629 to 48.684



PREPARED BY: Jared Loegering, PE

NORTH DAKOTA DEPARTMENT OF TRANSPORTATION
MATERIALS AND RESEARCH DIVISION

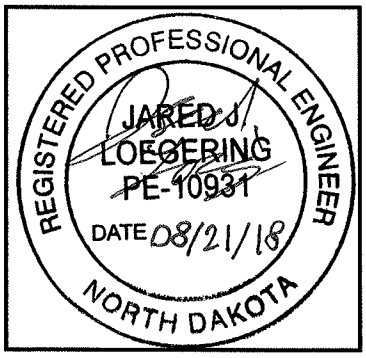
August 2018

SOIB-7-023(057)046

ND 23, 4 Bears Bridge to W New Town NW TRR

CERTIFICATION

I hereby certify that this report was prepared by me or under my direct supervision and that I am a duly registered professional engineer under the laws of the State of North Dakota. This document was originally issued and sealed by Jared J. Loegering, Registration number PE-10931 on 08/21/2018 and the original document is stored at the North Dakota Department of Transportation.

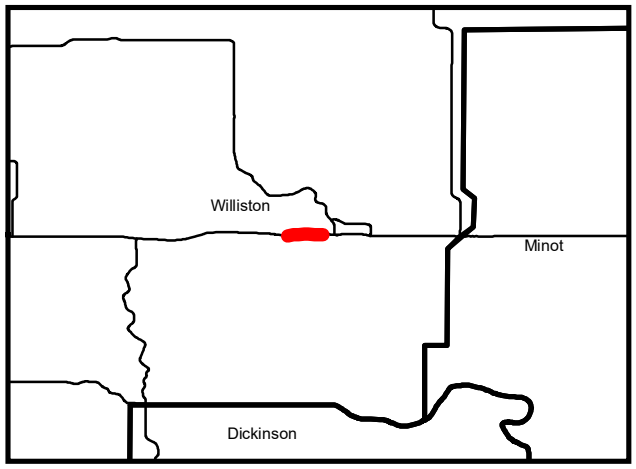


Jared J. Loegering, P.E.

08/21/2018
Date

Linear Soils Survey and Recommendations

Project: SOIB-7-023(057)046
PCN: 22159
Scope: Structural Improvement Mill & Overlay
Length: 2.2608 Miles
Location:
4 Bears Bridge to W New Town NW TRR



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Introduction

Location: ND 23, 4 Bears Bridge to W New Town NW TRR
Reference Points: 46.629 to 48.684
Project Length: 2.2608 Miles
Proposed Project Scope: Structural Improvement Mill & Overlay
Investigation Scope: Identified Maintenance Areas

Maintenance Review

Date of Maintenance Review: 05/30/2018
Materials and Research Person Conducting the Review: Jamie Naumann
Maintenance Person Conducting Review: Patrick Staples – New Town Maintenance Section

Table 1 – Identified Maintenance Areas

Location RP + Feet	Distress Identified	Maintenance Comments	Drilling Required
46+3321 to 48+3611	Transverse Cracks	Depressed transverse cracks	No
47+3766 to 47+3818	Alligator Cracking/Rutting	Misc. blade patched in 2017.	Yes
48+0000 to 48+3611	0.5” Rutting	Misc. chip patched in 2015.	Yes

Summary of Soil Investigation

The soil investigation was completed on 07/03/2018. The investigation consisted of 14 borings within the identified maintenance areas.

Table 2 – Boring Locations Summary

Boring Location	Justification for Boring	Boring depth	Location
47+3766 to 47+3818	Identified Maintenance Area	10'	1 boring within the identified area and 1 boring on either side approximately 100’ away. A total of 3 borings.
48+0000 to 48+3611	Identified Maintenance Area	10'	Conduct borings approximately every 500 feet within the identified area and 1 boring on either side approximately 100’ away. A total of 11 borings.

Maps of the boring locations are shown in Appendix C. The lab results are included in Appendix E.

Summary of Soil Analysis

The majority of the soils are sandy lean clays with AASHTO classifications of A-6 and A-7-6. These soils have on average a maximum dry density of approximately 126.5 lb/ft^3 and an average optimum water content of approximately 11%. The in-place moistures of the soils are on average 0% to 16% over optimum.

Soil Sample Distribution

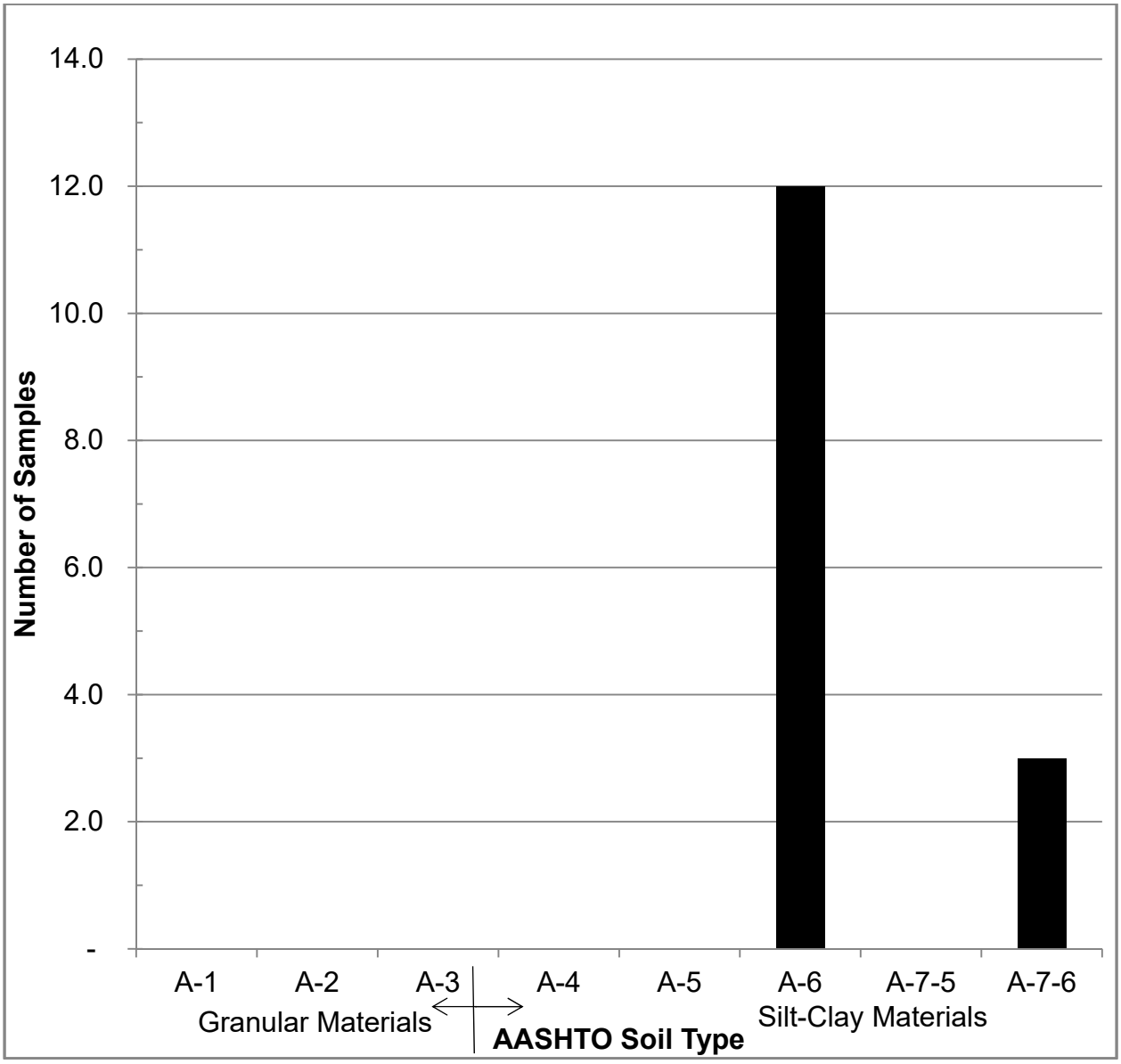


Figure 1 - Soil Sample Distribution

Design Recommendations

Project Limits – 46+3321 to 48+3611: The existing pavement distresses appear to be pavement related and there are no recommendations at this time.

Design Information

Compaction Method: T-180

Subgrade Prep: None

Subcut: None

Drainage: None

Plan Notes

None

The recommendations in this report are based on the scope specified in the Introduction. If the scope of work, vertical profile or horizontal alignment is changed, in either the conceptual phase or the design phase, the Geotechnical Engineer must be notified as soon as possible to ensure that there is adequate geotechnical information addressing these areas.

APPENDIX A

SOIL CLASSIFICATION

AASHTO Classification System

Table 5.1. AASHTO Classification System

General Classification	*Granular materials (35% or less passing No. 200 Sieve (0.075 mm)*							*Silt-clay Materials More than 35% passing No. 200 Sieve (0.075 mm)*			
Group Classification	*A—1*		*A—3*	*A—2*				*A—4*	*A—5*	*A—6*	*A—7*
	A—1—a	*A—1—b*		*A—2—4*	*A—2—5*	*A—2—6*	*A—2—7*				*A—7—5 A—7—6*
(*a*) Sieve Analysis: Percent Passing											
(*i*) 2.00 mm (No. 10)	50 max										
(*ii*) 0.425 mm (No. 40)	30 max	50 max	51 min								
(*iii*) 0.075 mm (No. 200)	15 max	25 max	10 max	35 max	35 max	35 max	35 max	36 min	36 min	36 min	36 min
(*b*) Characteristics of fraction passing 0.425 mm (No. 40)											
(*i*) Liquid limit				40 max	41 min	40 max	41 min	40 max	41 min	40 max	41 min
(*ii*) Plasticity index	6 max		N.P.	10 max	10 max	11 min	11 min	10 max	10 max	11 min	11 min*
(*c*) Usual types of significant Constituent materials	Stone Fragments Gravel and sand		Fine Sand	Silty or Clayey Gravel Sand				Silty Soils		Clayey Soils	
(*d*) General rating as subgrade.	Excellent to Good							Fair to Poor			

* If plasticity index is equal to or less than (liquid Limit—30), the soil is A—7—5 (*i.e.* PL > 30%)
If plasticity index is greater than (Liquid Limit—30), the soil is A—7—6 (*i.e.* PL < 30%)

Unified Soil Classification System, USCS

Table 5.2 Unified Soil Classification System (Based on Material Passing 76.2-mm Sieve)

Criteria for assigning group symbols				Group symbol
Coarse-grained soils More than 50% of retained on No. 200 sieve	Gravels More than 50% of coarse fraction retained on No. 4 sieve	Clean Gravels Less than 5% fines[a]	$C_u \geq 4$ and $1 \leq C_c \leq 3$[c]	GW
			$C_u < 4$ and/or $1 > C_c > 3$[c]	GP
		Gravels with Fines More than 12% fines[a,d]	$PI < 4$ or plots below "A" line (Figure 5.3)	GM
			$PI > 7$ and plots on or above "A" line (Figure 5.3)	GC
	Sands 50% or more of coarse fraction passes No. 4 sieve	Clean Sands Less than 5% fines[b]	$C_u \geq 6$ and $1 \leq C_c \leq 3$[c]	SW
			$C_u < 6$ and/or $1 > C_c > 3$[c]	SP
		Sands with Fines More than 12% fines[b,d]	$PI < 4$ or plots below "A" line (Figure 5.3)	SM
			$PI > 7$ and plots on or above "A" line (Figure 5.3)	SC
Fine-grained soils 50% or more passes No. 200 sieve	Silts and clays Liquid limit less than 50	Inorganic	$PI > 7$ and plots on or above "A" line (Figure 5.3)[e]	CL
			$PI < 4$ or plots below "A" line (Figure 5.3)[e]	ML
		Organic	$\frac{\text{Liquid limit — oven dried}}{\text{Liquid limit — not dried}} < 0.75$; see Figure 5.3; OL zone	OL
	Silts and clays Liquid limit 50 or more	Inorganic	PI plots on or above "A" line (Figure 5.3)	CH
			PI plots below "A" line (Figure 5.3)	MH
		Organic	$\frac{\text{Liquid limit — oven dried}}{\text{Liquid limit — not dried}} < 0.75$; see Figure 5.3; OH zone	OH
Highly Organic Soils	Primarily organic matter, dark in color, and organic odor			Pt

[a] Gravels with 5 to 12% fine require dual symbols: GW-GM, GW-GC, GP-GM, GP-GC.

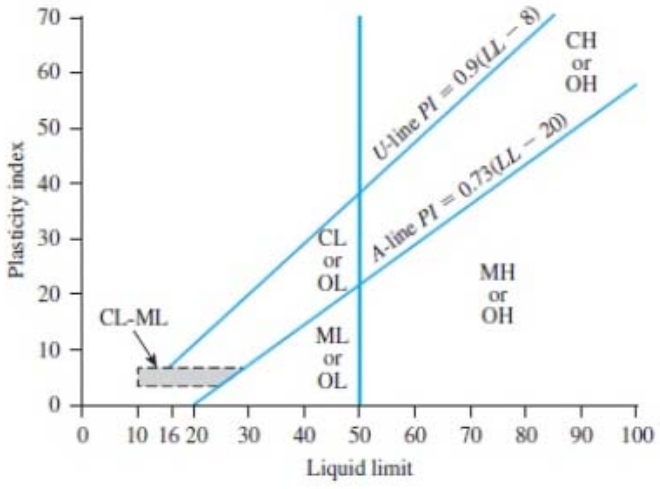
[b] Sands with 5 to 12% fines require dual symbols: SW-SM, SW-SC, SP-SM, SP-SC.

[c] $C_u = \frac{D_{60}}{D_{10}}$; $C_c = \frac{(D_{30})^2}{D_{60} \times D_{10}}$

[d] If $4 \leq PI \leq 7$ and plots in the hatched area in Figure 5.3, use dual symbol GC-GM or SC-SM.

[e] If $4 \leq PI \leq 7$ and plots in the hatched area in Figure 5.3, use dual symbol CL-ML.

Plasticity Chart :



APPENDIX B

MAINTENANCE REVIEW AND SUBSURFACE INVESTIGATION SCOPE

LINEAR SOILS SURVEY FIELD INVESTIGATION SCOPE

TO:	**File**
FROM:	**Kyle Evert – Materials and Research (Geotechnical)**
DATE:	**6/7/2018**
HIGHWAY:	**023.046**
PROJECT NUMBER:	**SOIB-7-023(057)046**
PCN:	**22159**
LOCATION:	**4 Bears Bridge E to W New Town NW TRR**
IMPROVEMENT SCOPE:	**Mill & Structural Overlay**
SUBJECT:	**Linear Soils Survey Subsurface Investigation Scope**

We have completed the Maintenance Review of the roadway (attached to this memo) and have circulated it to the Bismarck District for comments. The linear soils survey field investigation scope is based on the improvement strategy for the roadway as per Chapter 7 of the NDDOT Design Manual.

Improvement Strategy: Structural improvement
Investigation Scope: Identified Areas Only

The following table shows the proposed subsurface investigation scope.

Boring Location	Justification for Boring	Boring Depth	Location
47+3766 to 47+3818	Alligator Cracking	10 feet	Conduct 2 borings equal distance apart in the identified area and one boring on either side approximately 100 feet away. A total number of 4 borings.
48+0000 to 48+3611	Rutting	10 feet	Conduct 1 borings every 500 apart in the identified area and one boring on either side approximately 100 feet away. A total number of 9 borings.

The following are the associated tasks and dates for the completion of the Linear Soils Survey and Recommendations for this project.

Task	Completion (*Anticipated*) Date
Maintenance Review with District Maintenance Forces	5/30/2018
District Review of Findings from Previous Task	6/11/2018
Linear Soils Survey Field Work Complete	*6/20/2018*
Linear Soils Survey Lab Work	*8/15/2018*
Linear Soils Survey Report	*6/1/2018**
*Milestone Task	

PAVEMENT EVALUATION LOG FOR LINEAR SOIL SURVEY

North Dakota Department of Transportation, Materials & Research
SFN 60472 (9-2013)

Sheet 1 of 1

Project Number	PCN	Date of Survey
SOIB-7-023(057)046	22159	5/30/2018

Section Maintenance Contact	Completed By
Pat Staples	Jamie Naumann

Highway Reference Points	Surface Type
46+3321 to 48+3611	Asphalt

Location	Pavement Distress	Description	Maintenance Comment	Picture Number	Drilling Required
46+3321 to 48+3611	Transv. Cracks	Depressed			No
47+3766 to 47+3818	Aligator Cracking	Rutting	Misc. Blade patch 2017	1	Yes
48+0000 to 48+3611	Rutting	0.50"	Misc. chip patch 2015	2-3	Yes
	Select One				Select One
	Select One				Select One
	Select One				Select One
	Select One				Select One
	Select One				Select One
	Select One				Select One

Comments

1

47+3766 to 47+3611

2

3

48+0000 to 48+3611

APPENDIX C

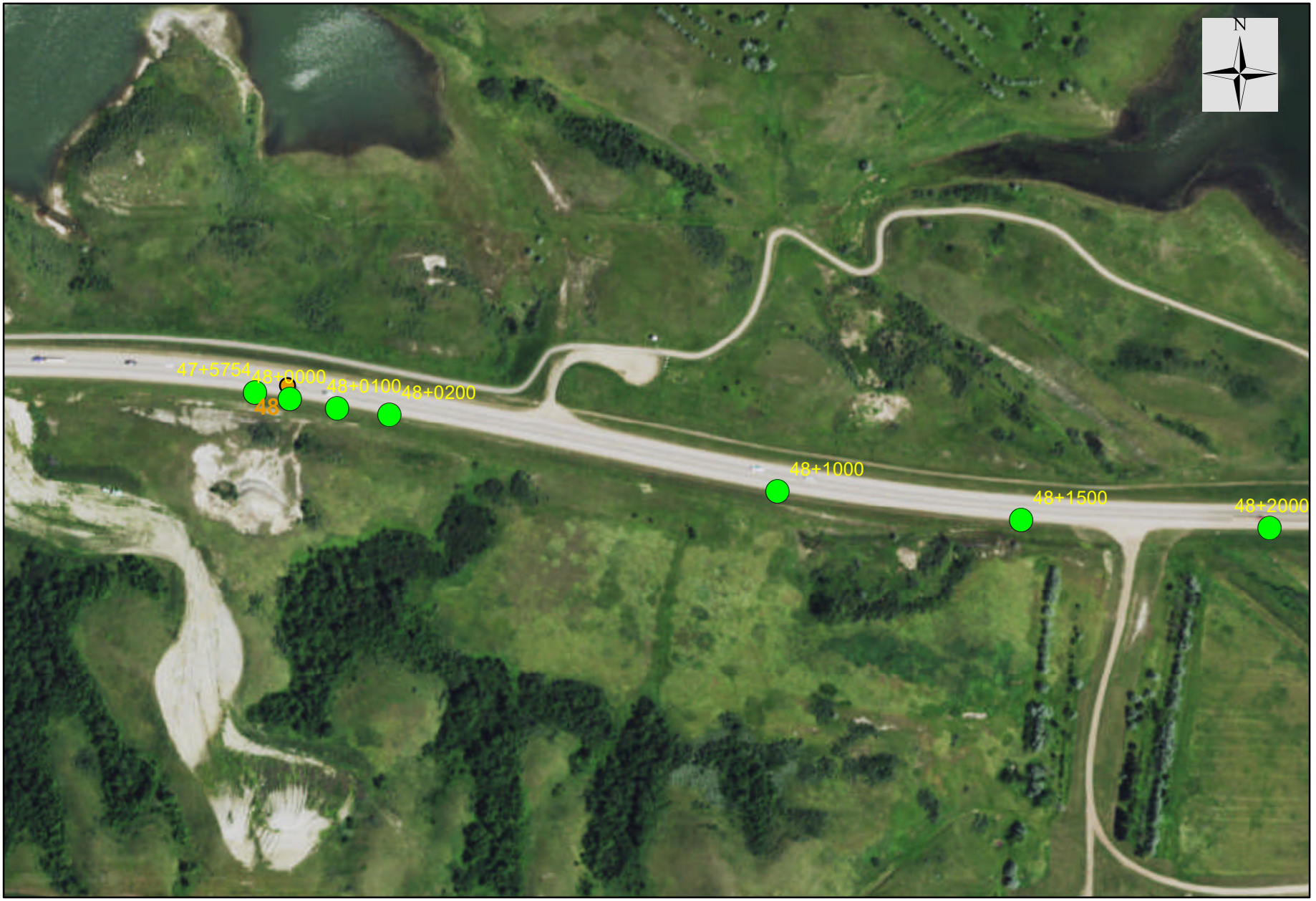
BORING LOCATIONS

Legend

- Reference Point
- Boring Locations

0 500 1,000 Feet

Project Number: SOIB-7-023(057)046



Legend

- Reference Point
- Boring Locations

0 500 1,000 Feet

Project Number: SOIB-7-023(057)046

Legend

- Reference Point
- Boring Locations

0 500 1,000 Feet

Project Number: SOIB-7-023(057)046

APPENDIX D

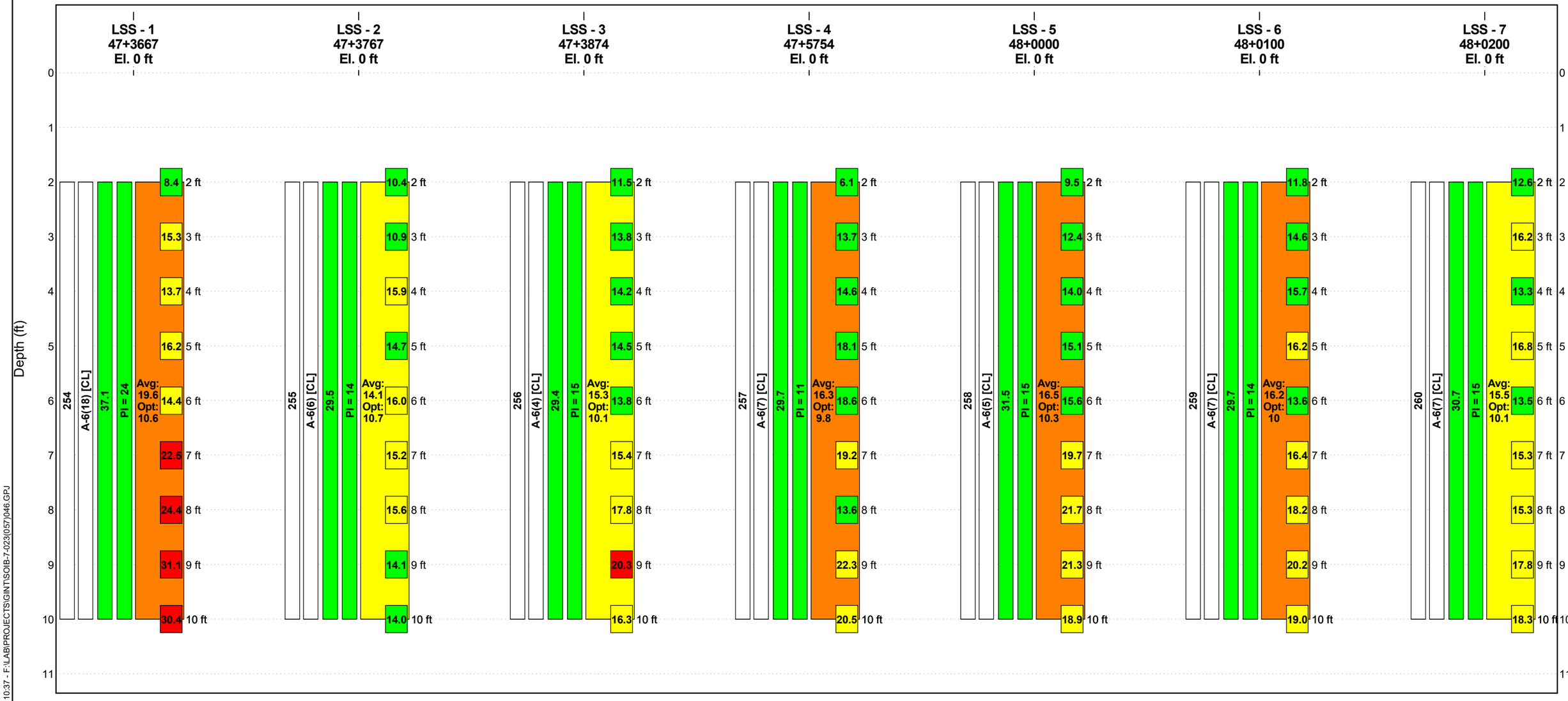
SUMMARY OF SOILS ANALYSIS

NDDOT North Dakota Department of Transportation

NORTH DAKOTA DEPARTMENT OF TRANSPORATION
300 AIRPORT ROAD
BISMARCK, ND 58504

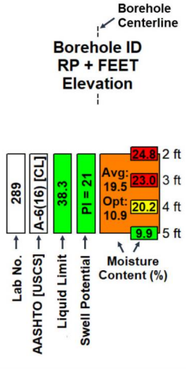
PROJECT NUMBER SOIB-7-023(057)046 **PCN** 22159

LOCATION Mountrail County

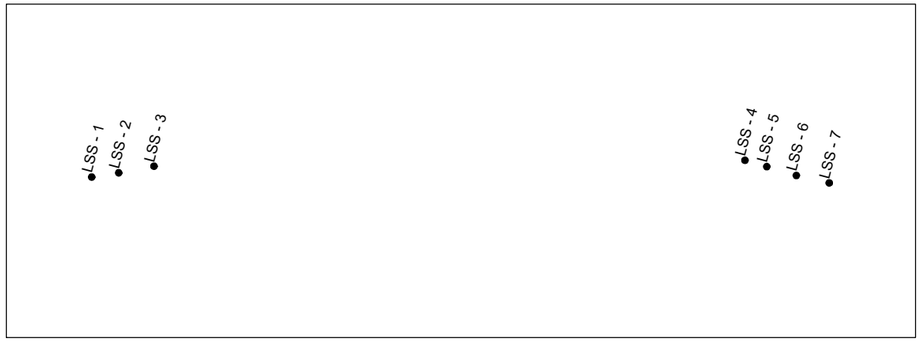


Boreholes Equally Spaced (0 to 800 ft)

LEGEND



Liquid Limit	LL<50	50<=LL<60	LL>=60	
Swell Potential	Low	Marginal	High	
Moisture Content	Below PL	0-5% Over PL	>5% Over PL	Non-Plastic
Avg. In-Place Moisture Content	MC < Opt	0<=MC<6% Over Opt	6<=MC<10% Over Opt	10<=MC<16% Over Opt	MC>16% Over Opt



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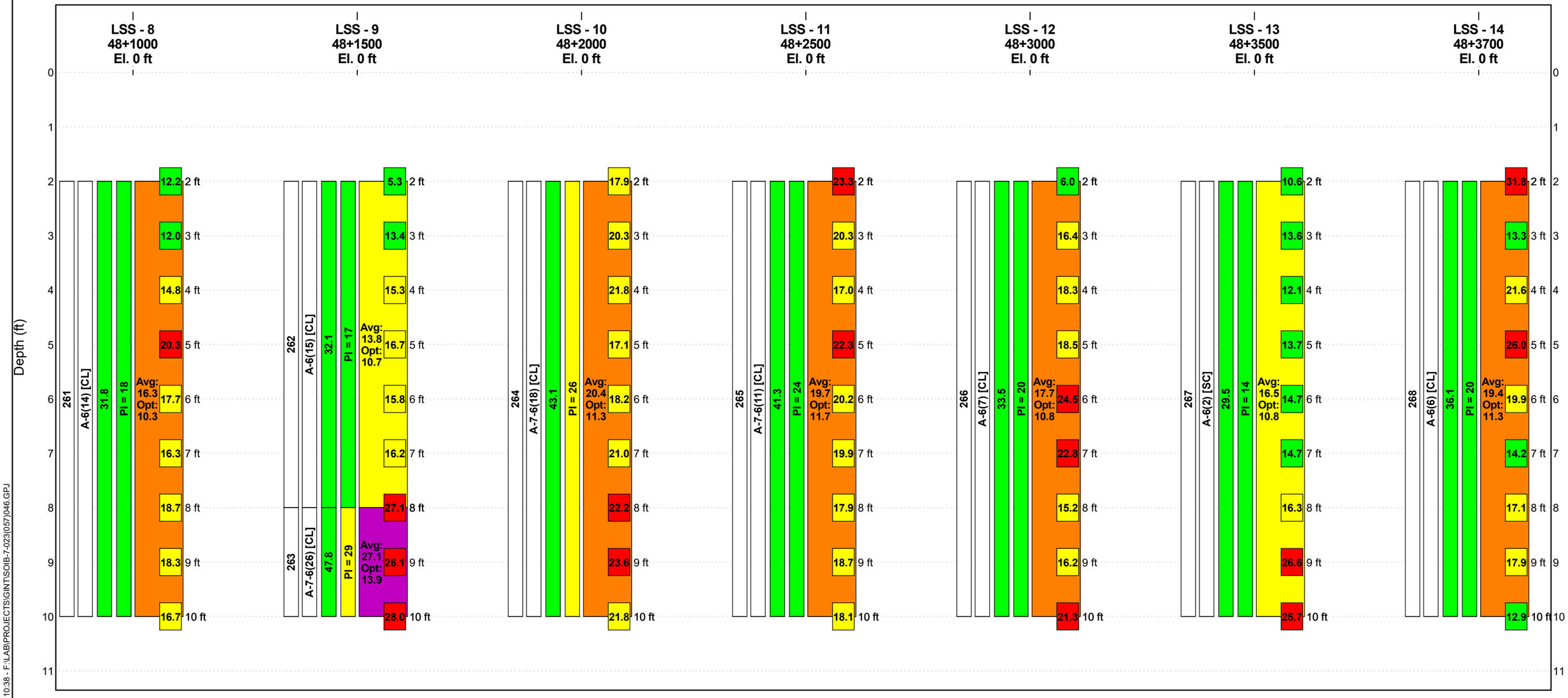
NDDOT
North Dakota Department of Transportation

NORTH DAKOTA DEPARTMENT OF TRANSPORATION
300 AIRPORT ROAD
BISMARCK, ND 58504

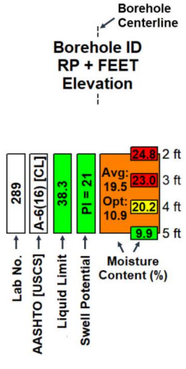
PROJECT NUMBER SOIB-7-023(057)046 **PCN** 22159

LOCATION Mountrail County

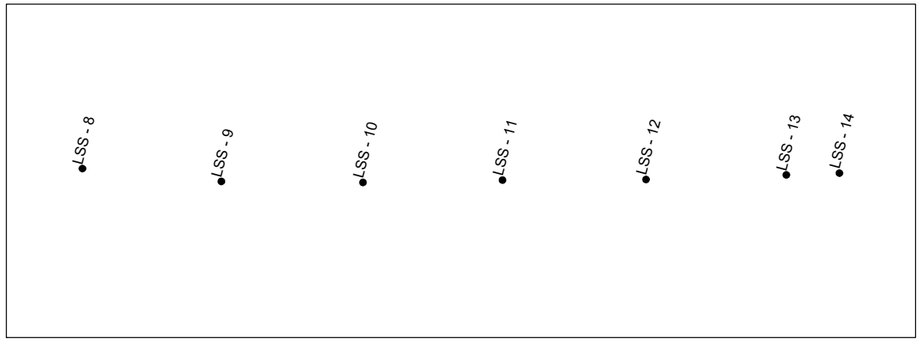


Boreholes Equally Spaced (0 to 900 ft)

LEGEND



Liquid Limit	LL<50	50<=LL<60	LL>=60	
Swell Potential	Low	Marginal	High	
Moisture Content	Below PL	0-5% Over PL	>5% Over PL	Non-Plastic
Avg. In-Place Moisture Content	MC < Opt	0<=MC<6% Over Opt	6<=MC<10% Over Opt	10<=MC<16% Over Opt	MC>16% Over Opt



APPENDIX E

LAB RESULTS

NDDOT North Dakota Department of Transportation

NORTH DAKOTA DEPARTMENT OF TRANSPORATION
300 AIRPORT ROAD
BISMARCK, ND 58504

SUMMARY OF LABORATORY RESULTS

PROJECT NUMBER SOIB-7-023(057)046 **LOCATION** Mountrail County

PCN 22159

Borehole	Depth	Liquid Limit	Plastic Limit	Plasticity Index	Maximum Size (mm)	%<#200 Sieve	AASHTO Classification	USCS Class-ification	Water Content (%)	Avg. Water Content (%)	Dry Density (pcf)	Satur-ation (%)	Void Ratio
LSS - 1	2.0	37	13	24	9.5	82	A-6 (18)	CL	8.4	19.6			
LSS - 1	3.0								15.3	19.6			
LSS - 1	4.0								13.7	19.6			
LSS - 1	5.0								16.2	19.6			
LSS - 1	6.0								14.4	19.6			
LSS - 1	7.0								22.5	19.6			
LSS - 1	8.0								24.4	19.6			
LSS - 1	9.0								31.1	19.6			
LSS - 1	10.0								30.4	19.6			
LSS - 2	2.0	29	15	14	9.5	63	A-6 (6)	CL	10.4	14.1			
LSS - 2	3.0								10.9	14.1			
LSS - 2	4.0								15.9	14.1			
LSS - 2	5.0								14.7	14.1			
LSS - 2	6.0								16.0	14.1			
LSS - 2	7.0								15.2	14.1			
LSS - 2	8.0								15.6	14.1			
LSS - 2	9.0								14.1	14.1			
LSS - 2	10.0								14.0	14.1			
LSS - 3	2.0	29	15	14	9.5	54	A-6 (4)	CL	11.5	15.3			
LSS - 3	3.0								13.8	15.3			
LSS - 3	4.0								14.2	15.3			
LSS - 3	5.0								14.5	15.3			
LSS - 3	6.0								13.8	15.3			
LSS - 3	7.0								15.4	15.3			
LSS - 3	8.0								17.8	15.3			
LSS - 3	9.0								20.3	15.3			
LSS - 3	10.0								16.3	15.3			
LSS - 4	2.0	30	19	11	25	76	A-6 (7)	CL	6.1	16.3			
LSS - 4	3.0								13.7	16.3			
LSS - 4	4.0								14.6	16.3			
LSS - 4	5.0								18.1	16.3			
LSS - 4	6.0								18.6	16.3			
LSS - 4	7.0								19.2	16.3			
LSS - 4	8.0								13.6	16.3			
LSS - 4	9.0								22.3	16.3			
LSS - 4	10.0								20.5	16.3			
LSS - 5	2.0	32	17	15	9.5	54	A-6 (5)	CL	9.5	16.5			
LSS - 5	3.0								12.4	16.5			
LSS - 5	4.0								14.0	16.5			
LSS - 5	5.0								15.1	16.5			
LSS - 5	6.0								15.6	16.5			
LSS - 5	7.0								19.7	16.5			
LSS - 5	8.0								21.7	16.5			

SUMMARY OF LABORATORY RESULTS

NORTH DAKOTA DEPARTMENT OF TRANSPORATION
300 AIRPORT ROAD
BISMARCK, ND 58504

PROJECT NUMBER SOIB-7-023(057)046 **LOCATION** Mountrail County

PCN 22159

Borehole	Depth	Liquid Limit	Plastic Limit	Plasticity Index	Maximum Size (mm)	%<#200 Sieve	AASHTO Classification	USCS Class-ification	Water Content (%)	Avg. Water Content (%)	Dry Density (pcf)	Satur-ation (%)	Void Ratio
LSS - 5	9.0								21.3	16.5			
LSS - 5	10.0								18.9	16.5			
LSS - 6	2.0	30	16	14	25	70	A-6 (7)	CL	11.8	16.2			
LSS - 6	3.0								14.6	16.2			
LSS - 6	4.0								15.7	16.2			
LSS - 6	5.0								16.2	16.2			
LSS - 6	6.0								13.6	16.2			
LSS - 6	7.0								16.4	16.2			
LSS - 6	8.0								18.2	16.2			
LSS - 6	9.0								20.2	16.2			
LSS - 6	10.0								19.0	16.2			
LSS - 7	2.0	31	15	16	25	60	A-6 (7)	CL	12.6	15.5			
LSS - 7	3.0								16.2	15.5			
LSS - 7	4.0								13.3	15.5			
LSS - 7	5.0								16.8	15.5			
LSS - 7	6.0								13.5	15.5			
LSS - 7	7.0								15.3	15.5			
LSS - 7	8.0								15.3	15.5			
LSS - 7	9.0								17.8	15.5			
LSS - 7	10.0								18.3	15.5			
LSS - 8	2.0	32	14	18	25	85	A-6 (14)	CL	12.2	16.3			
LSS - 8	3.0								12.0	16.3			
LSS - 8	4.0								14.8	16.3			
LSS - 8	5.0								20.3	16.3			
LSS - 8	6.0								17.7	16.3			
LSS - 8	7.0								16.3	16.3			
LSS - 8	8.0								18.7	16.3			
LSS - 8	9.0								18.3	16.3			
LSS - 8	10.0								16.7	16.3			
LSS - 9	2.0	32	15	17	9.5	93	A-6 (15)	CL	5.3	13.8			
LSS - 9	3.0								13.4	13.8			
LSS - 9	4.0								15.3	13.8			
LSS - 9	5.0								16.7	13.8			
LSS - 9	6.0								15.8	13.8			
LSS - 9	7.0								16.2	13.8			
LSS - 9	8.0	48	18	30	9.5	85	A-7-6 (26)	CL	27.1	27.1			
LSS - 9	9.0								26.1	27.1			
LSS - 9	10.0								28.0	27.1			
LSS - 10	2.0	43	17	26	25	75	A-7-6 (18)	CL	17.9	20.4			
LSS - 10	3.0								20.3	20.4			
LSS - 10	4.0								21.8	20.4			
LSS - 10	5.0								17.1	20.4			
LSS - 10	6.0								18.2	20.4			

SUMMARY OF LABORATORY RESULTS

NORTH DAKOTA DEPARTMENT OF TRANSPORATION
300 AIRPORT ROAD
BISMARCK, ND 58504

PROJECT NUMBER SOIB-7-023(057)046 **LOCATION** Mountrail County

PCN 22159

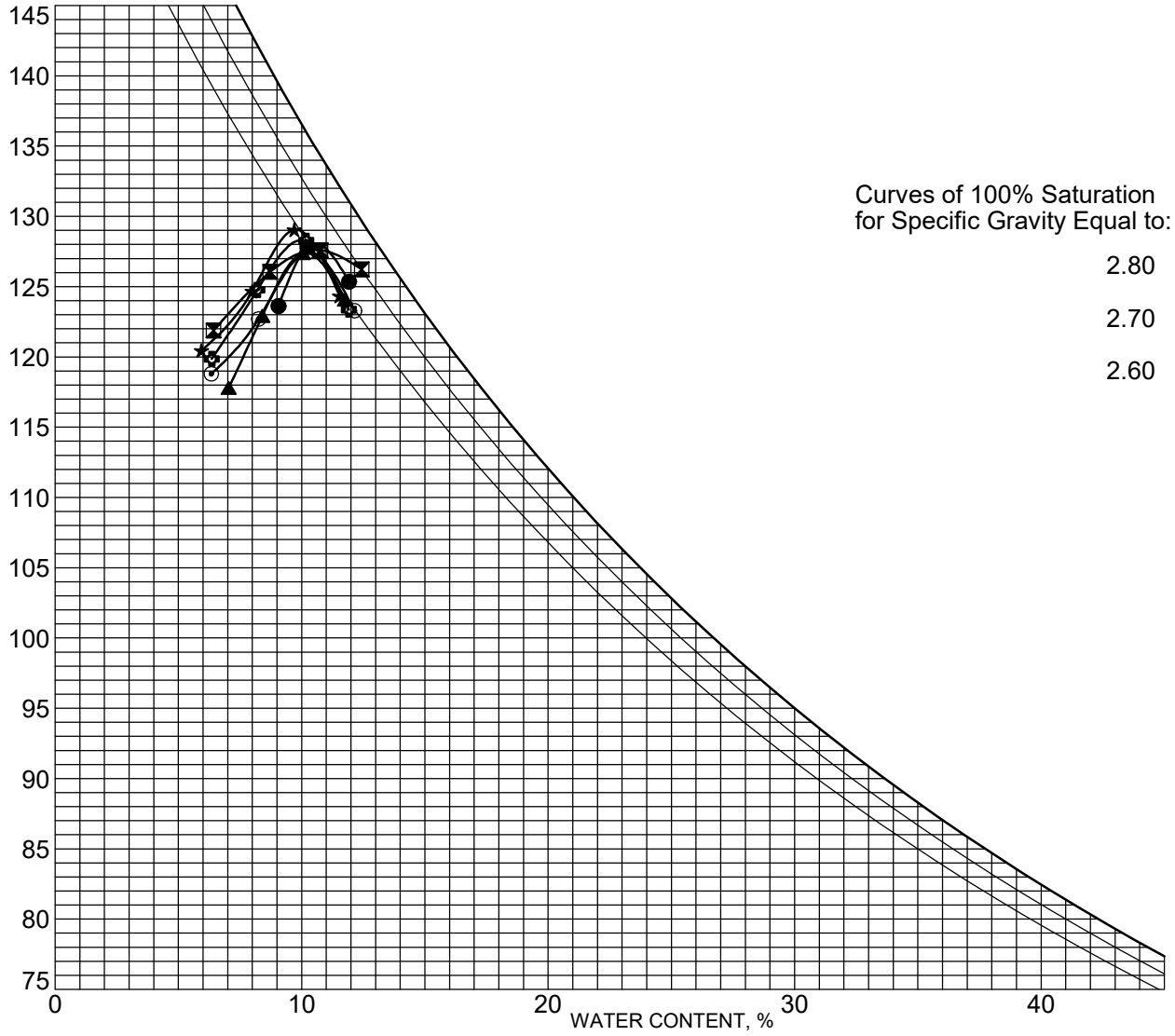
Borehole	Depth	Liquid Limit	Plastic Limit	Plasticity Index	Maximum Size (mm)	%<#200 Sieve	AASHTO Classification	USCS Class-ification	Water Content (%)	Avg. Water Content (%)	Dry Density (pcf)	Satur-ation (%)	Void Ratio
LSS - 10	7.0								21.0	20.4			
LSS - 10	8.0								22.2	20.4			
LSS - 10	9.0								23.6	20.4			
LSS - 10	10.0								21.8	20.4			
LSS - 11	2.0	41	17	24	25	58	A-7-6 (11)	CL	23.3	19.7			
LSS - 11	3.0								20.3	19.7			
LSS - 11	4.0								17.0	19.7			
LSS - 11	5.0								22.3	19.7			
LSS - 11	6.0								20.2	19.7			
LSS - 11	7.0								19.9	19.7			
LSS - 11	8.0								17.9	19.7			
LSS - 11	9.0								18.7	19.7			
LSS - 11	10.0								18.1	19.7			
LSS - 12	2.0	34	14	20	9.5	55	A-6 (7)	CL	6.0	17.7			
LSS - 12	3.0								16.4	17.7			
LSS - 12	4.0								18.3	17.7			
LSS - 12	5.0								18.5	17.7			
LSS - 12	6.0								24.5	17.7			
LSS - 12	7.0								22.8	17.7			
LSS - 12	8.0								15.2	17.7			
LSS - 12	9.0								16.2	17.7			
LSS - 12	10.0								21.3	17.7			
LSS - 13	2.0	29	15	14	25	39	A-6 (2)	SC	10.6	16.5			
LSS - 13	3.0								13.6	16.5			
LSS - 13	4.0								12.1	16.5			
LSS - 13	5.0								13.7	16.5			
LSS - 13	6.0								14.7	16.5			
LSS - 13	7.0								14.7	16.5			
LSS - 13	8.0								16.3	16.5			
LSS - 13	9.0								26.6	16.5			
LSS - 13	10.0								25.7	16.5			
LSS - 14	2.0	36	17	19	9.5	52	A-6 (6)	CL	31.8	19.4			
LSS - 14	3.0								13.3	19.4			
LSS - 14	4.0								21.6	19.4			
LSS - 14	5.0								26.0	19.4			
LSS - 14	6.0								19.9	19.4			
LSS - 14	7.0								14.2	19.4			
LSS - 14	8.0								17.1	19.4			
LSS - 14	9.0								17.9	19.4			
LSS - 14	10.0								12.9	19.4			

MOISTURE-DENSITY RELATIONSHIP

NORTH DAKOTA DEPARTMENT OF TRANSPORATION
300 AIRPORT ROAD
BISMARCK, ND 58504

PROJECT NUMBER SOIB-7-023(057)046 **LOCATION** Mountrail County

PCN 22159



BOREHOLE		DEPTH	AASHTO Classification	USCS Description
●	**LSS - 1**	**2.0**	**A-6 (18)**	**LEAN CLAY with SAND(CL)**
⊠	**LSS - 2**	**2.0**	**A-6 (6)**	**SANDY LEAN CLAY(CL)**
▲	**LSS - 3**	**2.0**	**A-6 (4)**	**SANDY LEAN CLAY(CL)**
★	**LSS - 4**	**2.0**	**A-6 (7)**	**LEAN CLAY with SAND(CL)**
⊙	**LSS - 5**	**2.0**	**A-6 (5)**	**SANDY LEAN CLAY(CL)**
✿	**LSS - 6**	**2.0**	**A-6 (7)**	**SANDY LEAN CLAY(CL)**

BOREHOLE		DEPTH	Test Method	LL	PL	PI	Max DD	Optimum WC
●	**LSS - 1**	**2.0**	**AASHTO T-180 Method A**	**37**	**13**	**24**	**128.1 PCF**	**10.6 %**
⊠	**LSS - 2**	**2.0**	**AASHTO T-180 Method A**	**29**	**15**	**14**	**127.6 PCF**	**10.7 %**
▲	**LSS - 3**	**2.0**	**AASHTO T-180 Method A**	**29**	**15**	**14**	**127.4 PCF**	**10.1 %**
★	**LSS - 4**	**2.0**	**AASHTO T-180 Method A**	**30**	**19**	**11**	**129.1 PCF**	**9.8 %**
⊙	**LSS - 5**	**2.0**	**AASHTO T-180 Method A**	**32**	**17**	**15**	**127.5 PCF**	**10.3 %**
✿	**LSS - 6**	**2.0**	**AASHTO T-180 Method A**	**30**	**16**	**14**	**128.3 PCF**	**10.0 %**

MOISTURE-DENSITY RELATIONSHIP

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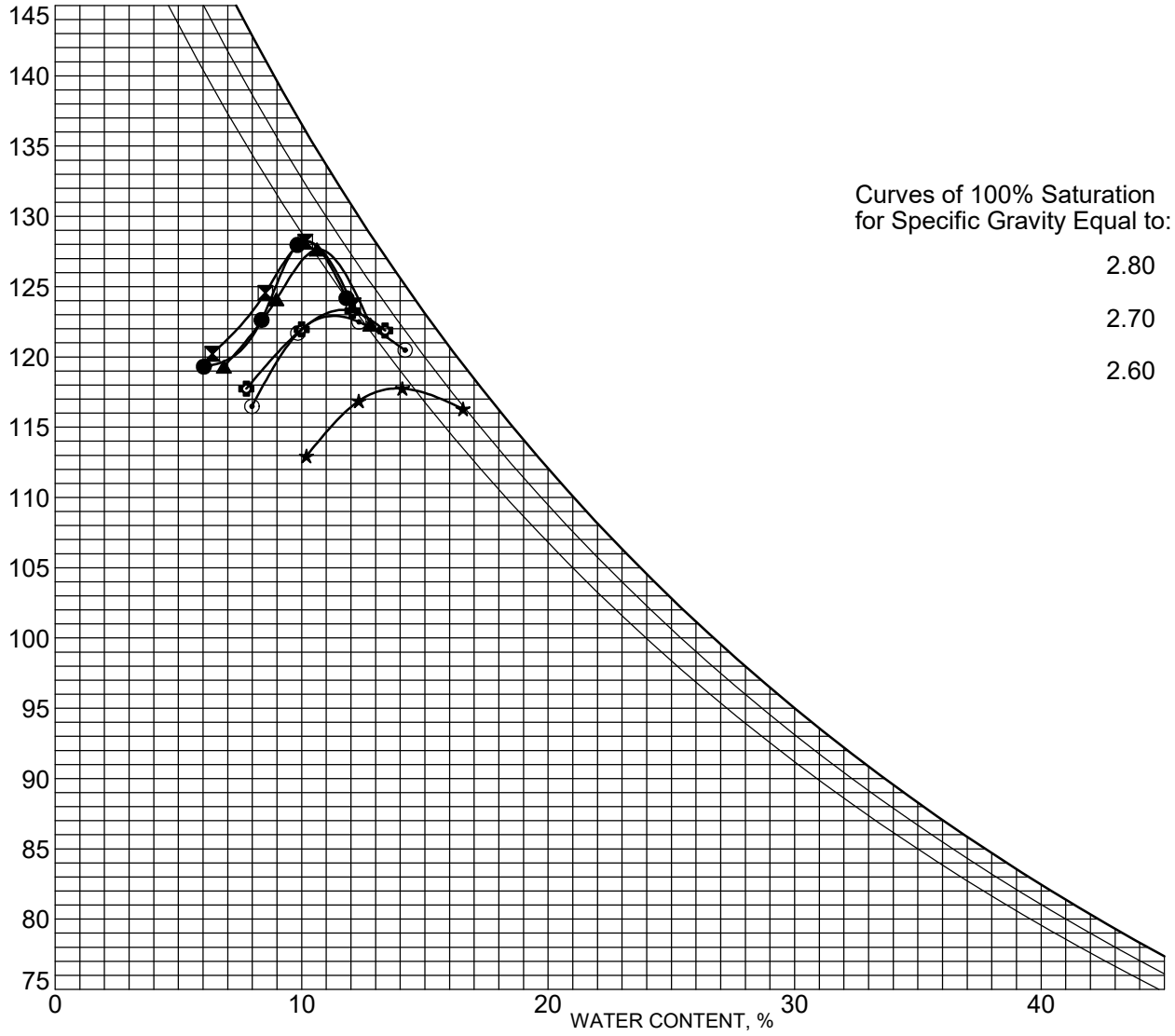

BOREHOLE		DEPTH	AASHTO Classification	USCS Description
●	**LSS - 7**	**2.0**	**A-6 (7)**	**SANDY LEAN CLAY(CL)**
⊠	**LSS - 8**	**2.0**	**A-6 (14)**	**LEAN CLAY(CL)**
▲	**LSS - 9**	**2.0**	**A-6 (15)**	**LEAN CLAY(CL)**
★	**LSS - 9**	**8.0**	**A-7-6 (26)**	**LEAN CLAY(CL)**
⊙	**LSS - 10**	**2.0**	**A-7-6 (18)**	**LEAN CLAY with SAND(CL)**
✿	**LSS - 11**	**2.0**	**A-7-6 (11)**	**SANDY LEAN CLAY(CL)**

BOREHOLE		DEPTH	Test Method	LL	PL	PI	Max DD	Optimum WC
●	**LSS - 7**	**2.0**	**AASHTO T-180 Method A**	**31**	**15**	**16**	**128.2 PCF**	**10.1 %**
⊠	**LSS - 8**	**2.0**	**AASHTO T-180 Method A**	**32**	**14**	**18**	**128.2 PCF**	**10.3 %**
▲	**LSS - 9**	**2.0**	**AASHTO T-180 Method A**	**32**	**15**	**17**	**127.7 PCF**	**10.7 %**
★	**LSS - 9**	**8.0**	**AASHTO T-180 Method A**	**48**	**18**	**30**	**117.8 PCF**	**13.9 %**
⊙	**LSS - 10**	**2.0**	**AASHTO T-180 Method A**	**43**	**17**	**26**	**122.9 PCF**	**11.3 %**
✿	**LSS - 11**	**2.0**	**AASHTO T-180 Method A**	**41**	**17**	**24**	**123.4 PCF**	**11.7 %**

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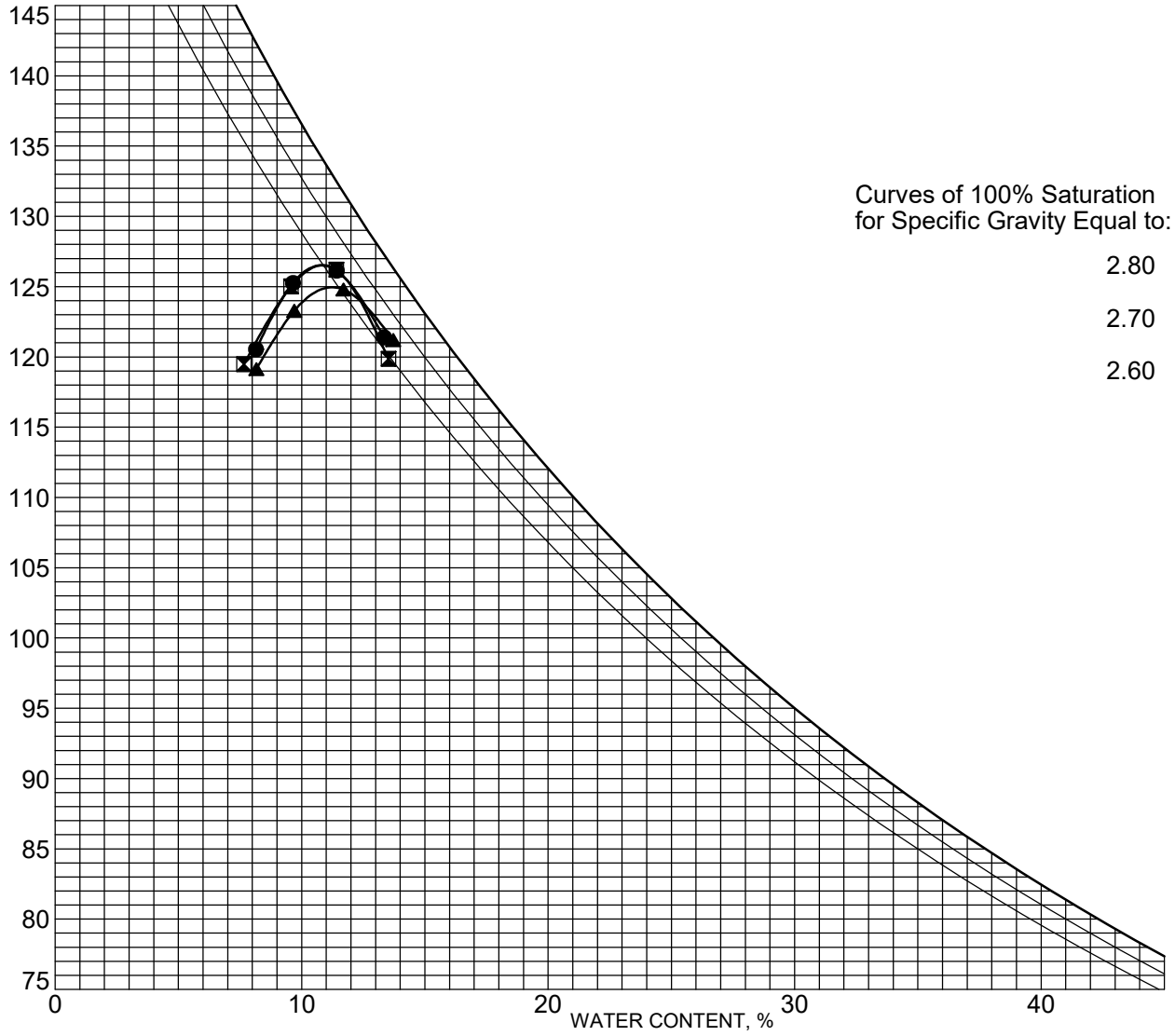

BOREHOLE		DEPTH	AASHTO Classification	USCS Description
●	**LSS - 12**	**2.0**	**A-6 (7)**	**SANDY LEAN CLAY(CL)**
⊠	**LSS - 13**	**2.0**	**A-6 (2)**	**CLAYEY SAND(SC)**
▲	**LSS - 14**	**2.0**	**A-6 (6)**	**SANDY LEAN CLAY(CL)**

BOREHOLE		DEPTH	Test Method	LL	PL	PI	Max DD	Optimum WC
●	**LSS - 12**	**2.0**	**AASHTO T-180 Method A**	**34**	**14**	**20**	**126.5 PCF**	**10.8 %**
⊠	**LSS - 13**	**2.0**	**AASHTO T-180 Method A**	**29**	**15**	**14**	**126.5 PCF**	**10.8 %**
▲	**LSS - 14**	**2.0**	**AASHTO T-180 Method A**	**36**	**17**	**19**	**125.0 PCF**	**11.3 %**

GRAIN SIZE DISTRIBUTION

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BISMARCK, ND 58504

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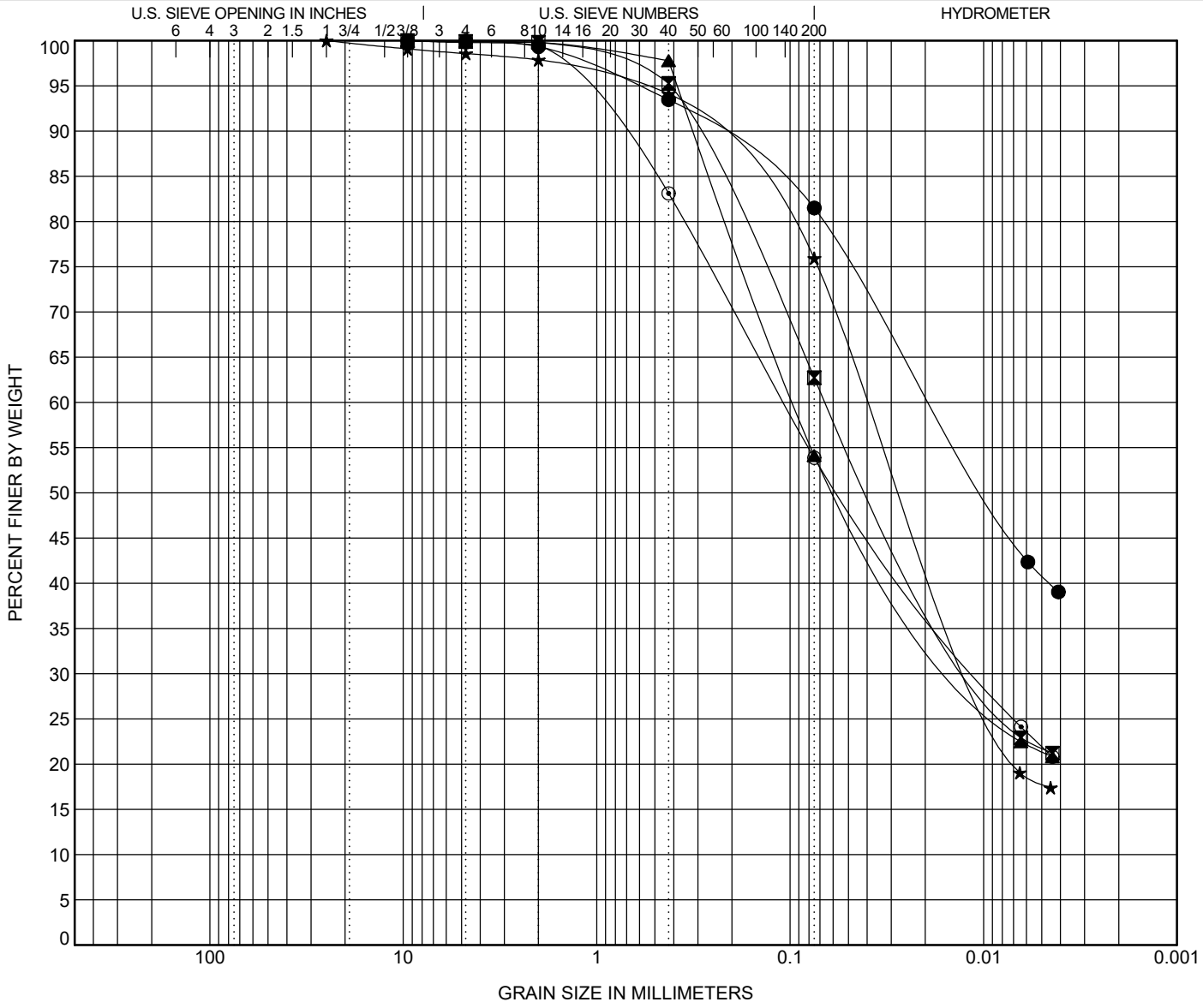

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

BOREHOLE	DEPTH	AASHTO Classification	USCS Classification	LL	PL	PI	Cc	Cu
● LSS - 1	2.0	A-6 (18)	CL	37	13	24		
⊠ LSS - 2	2.0	A-6 (6)	CL	29	15	14		
▲ LSS - 3	2.0	A-6 (4)	CL	29	15	14		
★ LSS - 4	2.0	A-6 (7)	CL	30	19	11		
⊙ LSS - 5	2.0	A-6 (5)	CL	32	17	15		

BOREHOLE	DEPTH	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● LSS - 1	2.0	9.5	0.019			0.0	18.5	40.7	40.8
⊠ LSS - 2	2.0	9.5	0.063	0.01		0.1	37.2	40.9	21.8
▲ LSS - 3	2.0	9.5	0.095	0.011		0.1	45.8	32.7	21.4
★ LSS - 4	2.0	25	0.038	0.01		1.4	22.6	58.1	17.9
⊙ LSS - 5	2.0	9.5	0.108	0.01		0.2	45.9	31.9	21.9

GRAIN SIZE DISTRIBUTION

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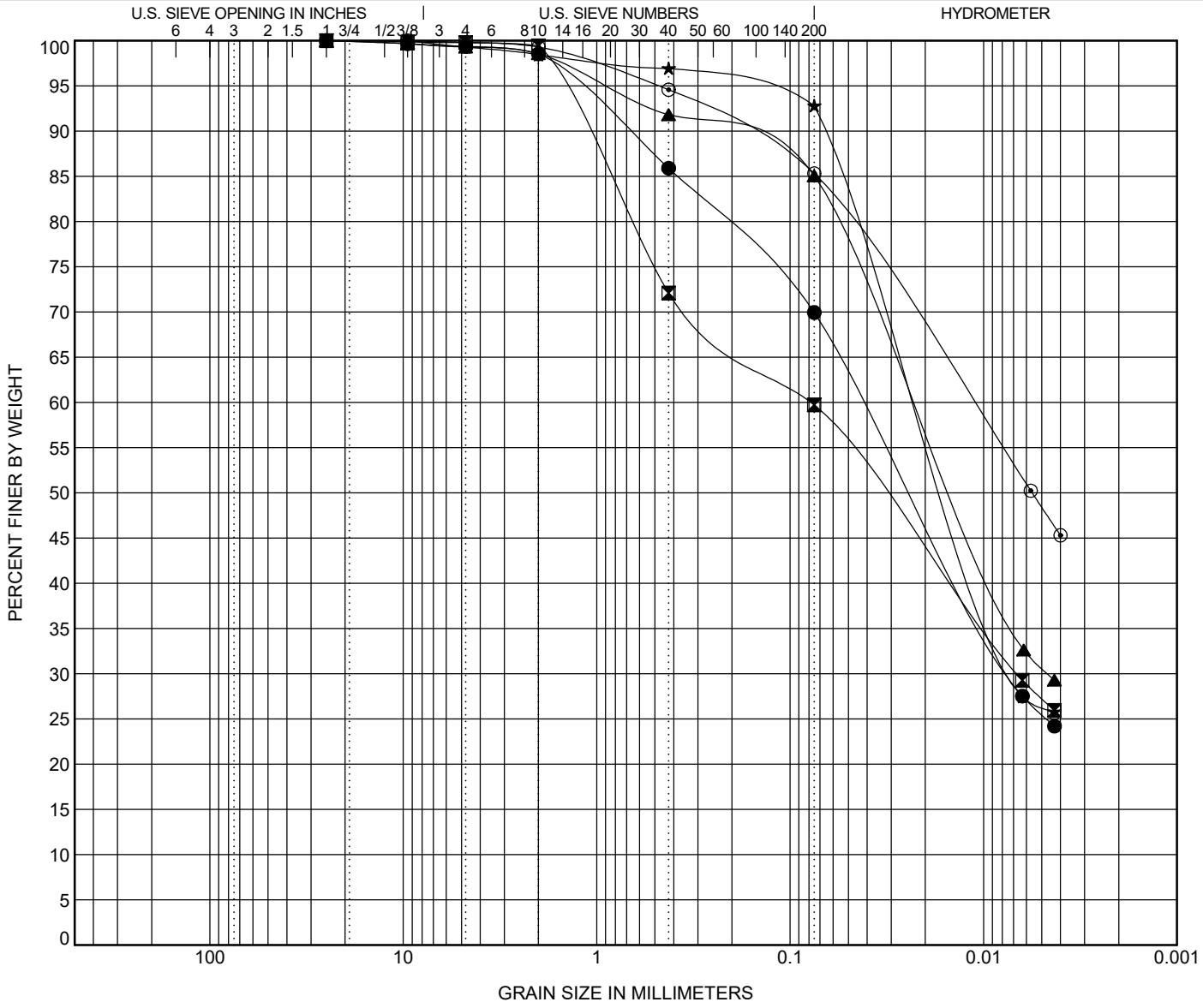

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

BOREHOLE	DEPTH	AASHTO Classification	USCS Classification	LL	PL	PI	Cc	Cu
● LSS - 6	2.0	A-6 (7)	CL	30	16	14		
⊠ LSS - 7	2.0	A-6 (7)	CL	31	15	16		
▲ LSS - 8	2.0	A-6 (14)	CL	32	14	18		
★ LSS - 9	2.0	A-6 (15)	CL	32	15	17		
⊙ LSS - 9	8.0	A-7-6 (26)	CL	48	18	30		

BOREHOLE	DEPTH	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● LSS - 6	2.0	25	0.042	0.007		0.6	29.4	44.4	25.5
⊠ LSS - 7	2.0	25	0.078	0.007		0.2	40.1	32.5	27.3
▲ LSS - 8	2.0	25	0.023	0.005		0.7	14.2	54.4	30.7
★ LSS - 9	2.0	9.5	0.022	0.007		0.7	6.5	66.4	26.5
⊙ LSS - 9	8.0	9.5	0.012			0.2	14.5	36.9	48.4

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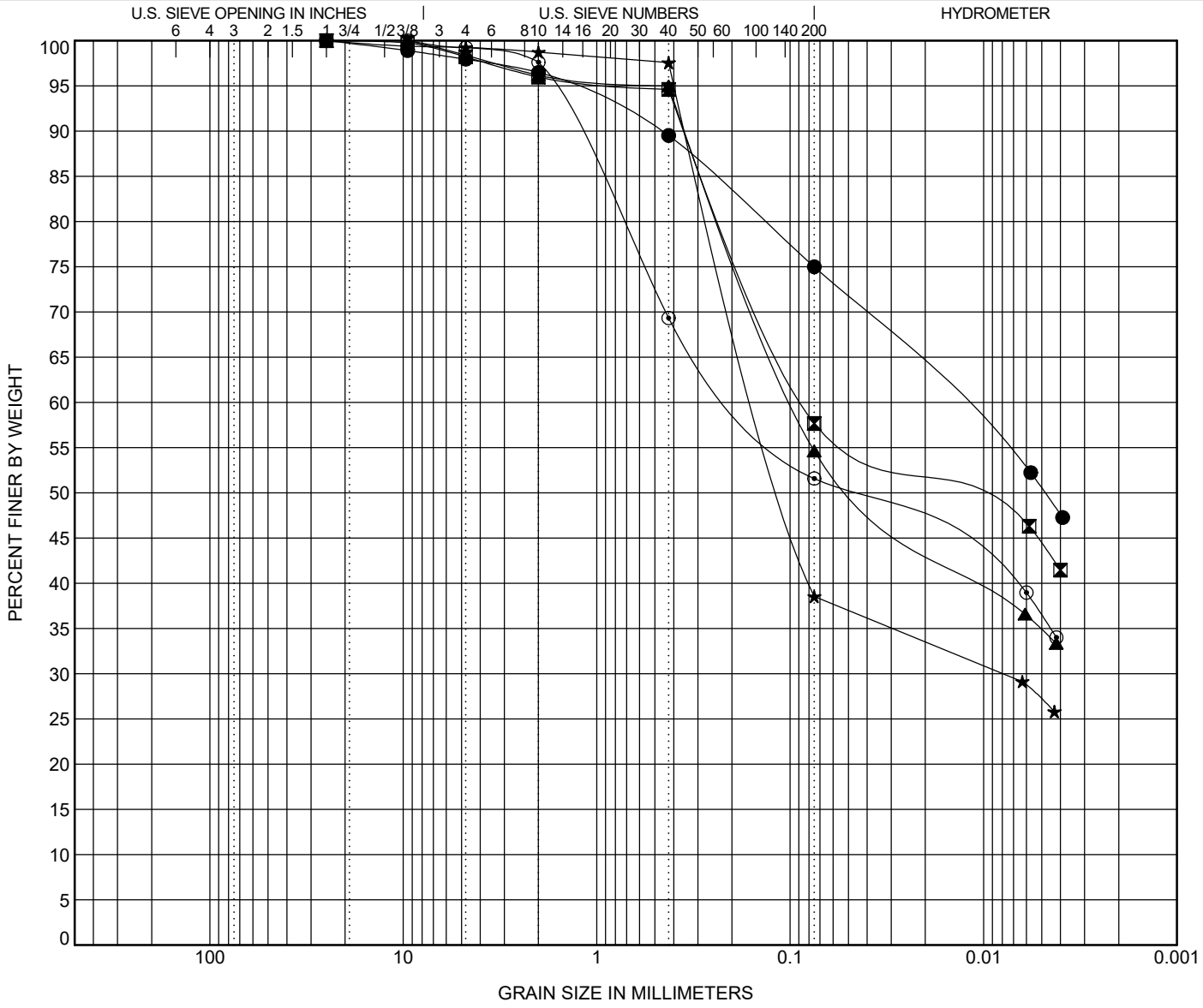

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BOREHOLE	DEPTH	AASHTO Classification	USCS Classification	LL	PL	PI	Cc	Cu
●	**LSS - 10**	**2.0**	**A-7-6 (18)**	**CL**	**43**	**17**	**26**		
⊠	**LSS - 11**	**2.0**	**A-7-6 (11)**	**CL**	**41**	**17**	**24**		
▲	**LSS - 12**	**2.0**	**A-6 (7)**	**CL**	**34**	**14**	**20**		
★	**LSS - 13**	**2.0**	**A-6 (2)**	**SC**	**29**	**15**	**14**		
⊙	**LSS - 14**	**2.0**	**A-6 (6)**	**CL**	**36**	**17**	**19**		

	BOREHOLE	DEPTH	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**LSS - 10**	**2.0**	**25**	**0.014**			**2.1**	**22.9**	**24.5**	**50.5**
⊠	**LSS - 11**	**2.0**	**25**	**0.084**			**1.8**	**40.5**	**13.3**	**44.4**
▲	**LSS - 12**	**2.0**	**9.5**	**0.094**			**1.6**	**43.8**	**19.8**	**34.9**
★	**LSS - 13**	**2.0**	**25**	**0.141**	**0.008**		**0.8**	**60.7**	**11.4**	**27.1**
⊙	**LSS - 14**	**2.0**	**9.5**	**0.171**			**0.8**	**47.7**	**15.1**	**36.4**